

WHAT IS CLAIMED IS:

1. A device for monitoring dripping of a fluid from a fluid channel, the device comprising a capacitor, being formed on or integrated with the fluid channel, and electrical contacts, connecting said capacitor to a capacitance measuring device, said capacitor is designed and constructed so that a change in a capacitance thereof represents a formation of a drop near an edge of the fluid channel.
2. The device of claim 1, wherein the fluid is selected from the group consisting of water, a body fluid, a bacterial cell suspension, a protein solution, an antibody solution, a nucleic acid solution and ink.
3. The device of claim 1, wherein said capacitor is positioned in proximity to said edge of the fluid channel.
4. The device of claim 1, wherein the fluid channel is a capillary.
5. The device of claim 4, wherein said capacitor comprises two conductive plates engaging opposite faces of said capillary.
6. The device of claim 4, wherein said capillary has a profile selected from the group consisting of a polygonal profile, a circular profile, an ellipsoidal profile and an irregular pattern profile.
7. The device of claim 1, wherein the fluid channel is an HPLC column.
8. The device of claim 7, wherein said capacitor comprises two conductive plates engaging opposite faces of said HPLC column.
9. The device of claim 7, further comprising said capacitance measuring device and electronic circuitry, communicating with said capacitance measuring device and operable to signal an automatic system to selectively collect drops.

10. The device of claim 1, wherein the fluid channel is a microchannel of a microfluidic device.

11. The device of claim 10, wherein said capacitor comprises two conductive plates engaging opposite walls of said microchannel.

12. The device of claim 10, wherein said microfluidic device is selected from the group consisting of a drop ejector, a droplet microswitch, an extracellular electrode and a multi electrode array.

13. The device of claim 1, wherein said capacitance measuring device is selected from the group consisting of a capacitance meter and a capacitance bridge.

14. The device of claim 1, wherein a size of said capacitor is in a nanometer scale.

15. The device of claim 1, wherein a size of said capacitor is in a millimeter scale.

16. The device of claim 1, wherein a size of said capacitor is in a centimeter scale.

17. The device of claim 1, wherein said capacitance measuring device is configured and designed to allow measuring of capacitance at a resolution of less than about 10 % of a total capacitance of said capacitor.

18. A device for controlling fluid locomotion in a fluid channel, the device comprising:

(a) a capacitor, being formed on or integrated with the fluid channel and having a variable cross-sectional area; and

(b) electrical contacts, connecting said capacitor to a voltage source;

said capacitor being operable to induce polarization on molecules of the fluid so as to generate dielectrophoretic forces thereon thereby to control fluid locomotion.

19. The device of claim 18, wherein the fluid is selected from the group consisting of water, a body fluid, a bacterial cell suspension, a protein solution, an antibody solution, a nucleic acid solution and ink.

20. The device of claim 18, wherein said capacitor is positioned in proximity to an edge of the fluid channel, so as to control a rate of drop formation near said edge.

21. The device of claim 18, wherein said capacitor is positioned in proximity to an edge of the fluid channel, so as to control a shape and/or size of a drop formed near said edge.

22. The device of claim 18, wherein said capacitor comprises two conductive plates defining an inter-plate volume having a longitudinal axis, said conductive plates having constant transverse dimensions along said longitudinal axis.

23. The device of claim 18, wherein said capacitor comprises two conductive plates defining an inter-plate volume having a longitudinal axis, said conductive plates having a variable transverse dimensions along said longitudinal axis.

24. The device of claim 18, wherein the fluid channel is a capillary.

25. The device of claim 24, wherein said capacitor comprises two conductive plates engaging opposite faces of said capillary.

26. The device of claim 24, wherein said capillary has a profile selected from the group consisting of a polygonal profile, a circular profile, an ellipsoidal profile and an irregular pattern profile.

27. The device of claim 18, wherein the fluid channel is an HPLC column.

28. The device of claim 27, wherein said capacitor comprises two conductive plates engaging opposite faces of said HPLC column.

29. The device of claim 27, further comprising said capacitance measuring device and electronic circuitry, communicating with said capacitance measuring device and operable to signal an automatic system to selectively collect drops.

30. The device of claim 18, wherein the fluid channel is a microchannel of a microfluidic device.

31. The device of claim 30, wherein said capacitor comprises two conductive plates engaging opposite walls of said microchannel.

32. The device of claim 30, wherein said microfluidic device is selected from the group consisting of a drop ejector, a droplet microswitch, an extracellular electrode, a multi electrode array, a lab-on-chip device and a drug delivery microdevice.

33. The device of claim 18, wherein a size of said capacitor is in a nanometer scale.

34. The device of claim 18, wherein a size of said capacitor is in a millimeter scale.

35. The device of claim 18, wherein a size of said capacitor is in a centimeter scale.

36. A device for monitoring fluid locomotion in a fluid channel, the device comprising:

(a) a capacitor, being formed on or integrated with the fluid channel and having a variable cross-sectional area; and

(b) electrical contacts, connecting said capacitor to a capacitance measuring device;

said variable cross-sectional area is selected so that a change in a capacitance of said capacitor represents a location of the fluid in the fluid channel.

37. The device of claim 36, wherein the fluid is selected from the group consisting of water, a body fluid, a bacterial cell suspension, a protein solution, an antibody solution, a nucleic acid solution and ink.

38. The device of claim 36, wherein said capacitor is positioned in proximity to an edge of the fluid channel, so as to monitor a rate of drop formation near said edge.

39. The device of claim 36, wherein said capacitor comprises two conductive plates defining an inter-plate volume having a longitudinal axis, said conductive plates having constant transverse dimensions along said longitudinal axis.

40. The device of claim 36, wherein said capacitor comprises two conductive plates defining an inter-plate volume having a longitudinal axis, said conductive plates having a variable transverse dimensions along said longitudinal axis.

41. The device of claim 36, wherein the fluid channel is a capillary.

42. The device of claim 41, wherein said capacitor comprises two conductive plates engaging opposite faces of said capillary.

43. The device of claim 41, wherein said capillary has a profile selected from the group consisting of a polygonal profile, a circular profile, an ellipsoidal profile and an irregular pattern profile.

44. The device of claim 36, wherein the fluid channel is an HPLC column.

45. The device of claim 44, wherein said capacitor comprises two conductive plates engaging opposite faces of said HPLC column.

46. The device of claim 36, wherein the fluid channel is a microchannel of a microfluidic device.

47. The device of claim 46, wherein said capacitor comprises two conductive plates engaging opposite walls of said microchannel.

48. The device of claim 46, wherein said microfluidic device is selected from the group consisting of a drop ejector, a droplet microswitch, an extracellular electrode, a multi electrode array, a lab-on-chip device and a drug delivery microdevice.

49. The device of claim 36, wherein a size of said capacitor is in a nanometer scale.

50. The device of claim 36, wherein a size of said capacitor is in a millimeter scale.

51. The device of claim 36, wherein a size of said capacitor is in a centimeter scale.

52. The device of claim 36, wherein said capacitance measuring device is selected from the group consisting of a capacitance meter and a capacitance bridge.

53. The device of claim 36, wherein said capacitance measuring device is configured and designed to allow measuring of capacitance at a resolution of less than about 10 % of a total capacitance of said capacitor.

54. A method of manufacturing a device for monitoring dripping of a fluid, the method comprising:

(a) positioning a capacitor on a fluid channel in a manner that a change in a capacitance of said capacitor represents a formation of a drop near an edge of said fluid channel; and

(b) connecting said capacitor to a capacitance measuring device using electrical contacts.

55. The method of claim 54, wherein the fluid is selected from the group consisting of water, a body fluid, a bacterial cell suspension, a protein solution, an antibody solution, a nucleic acid solution and ink.

56. The method of claim 54, wherein said capacitor is positioned in proximity to said edge of the fluid channel.

57. The method of claim 54, wherein the fluid channel is a capillary.

58. The method of claim 57, wherein said step of positioning said capacitor comprises:

- (i) providing a pullable tube having a profile;
- (ii) pulling said tube at a controlled rate so as to provide a capillary having a predetermined profile; and
- (iii) applying two conductive plates on opposite faces of said capillary.

59. The method of claim 58, wherein said step of applying is effected from a procedure selected from the group consisting of evaporation, lift-off shadow-evaporation, nano-manipulation and focused ion milling.

60. The method of claim 57, wherein said capillary has a profile selected from the group consisting of a polygonal profile, a circular profile, an ellipsoidal profile and an irregular pattern profile.

61. The method of claim 54, wherein the fluid channel is an HPLC column.

62. The method of claim 61, wherein said step of positioning said capacitor comprises:

- (i) providing a capillary;
- (ii) applying two conductive plates on opposite faces of said capillary; and
- (iii) filling said capillary with an HPLC stationary phase.

63. The method of claim 62, wherein said step of applying is effected from a procedure selected from the group consisting of evaporation, lift-off shadow-evaporation, nano-manipulation and focused ion milling.

64. The method of claim 54, wherein the fluid channel is a microchannel of a microfluidic device.

65. The method of claim 64, wherein said step of positioning said capacitor comprises:

- (i) etching a non conductive substrate so as to provide a microchannel having walls; and
- (ii) applying two conductive plates on opposite walls of said microchannel.

66. The method of claim 65, wherein said step of applying said two conductive plates comprises coating said opposite walls by a conductive material.

67. The method of claim 65, wherein said step of applying said two conductive plates is by ion implantation.

68. The method of claim 64, wherein said microfluidic device is selected from the group consisting of a drop ejector, a droplet microswitch an extracellular electrode and a multi electrode array.

69. The method of claim 54, wherein said step of connecting said capacitor to said capacitance measuring device is effected by a procedure selected from the group consisting of patterning, evaporation and ion implantation.

70. The method of claim 69, wherein said patterning is effected by a procedure selected from the group consisting of photolithography and lift-off technique.

71. The method of claim 54, wherein said electrical contacts comprise bonding pads.

72. The method of claim 54, wherein said capacitance measuring device is selected from the group consisting of a capacitance meter and a capacitance bridge.

73. The method of claim 54, wherein a size of said capacitor is in a nanometer scale.

74. The method of claim 54, wherein a size of said capacitor is in a millimeter scale.

75. The method of claim 54, wherein a size of said capacitor is in a centimeter scale.

76. The method of claim 54, wherein said capacitance measuring device is configured and designed to allow measuring of capacitance at a resolution of less than about 10 % of a total capacitance of said capacitor.

77. A method of manufacturing a device for controlling fluid locomotion, the method comprising:

(a) positioning a capacitor having a variable cross-sectional area on a fluid channel, said capacitor being operable to induce polarization on molecules of the fluid so as to generate dielectrophoretic forces thereon thereby to control fluid locomotion; and

(b) connecting said capacitor to a voltage source using electrical contacts.

78. The method of claim 77, wherein the fluid is selected from the group consisting of water, a body fluid, a bacterial cell suspension, a protein solution, an antibody solution, a nucleic acid solution and ink.

79. The method of claim 77, wherein said capacitor is positioned in proximity to an edge of the fluid channel, so as to control a rate of drop formation near said edge.

80. The method of claim 18, wherein said capacitor is positioned in proximity to an edge of the fluid channel, so as to control a shape and/or size of a drop formed near said edge.

81. The method of claim 77, wherein the fluid channel is a capillary.

82. The method of claim 81, wherein said step of positioning said capacitor comprises:

- (i) providing a pullable tube having a profile;
- (ii) pulling said tube at a controlled rate so as to provide a capillary having a predetermined profile; and
- (iii) applying two conductive plates on opposite faces of said capillary.

83. The method of claim 82, wherein said step of applying is effected from a procedure selected from the group consisting of evaporation, lift-off shadow-evaporation, nano-manipulation and focused ion milling.

84. The method of claim 81, wherein said capillary has a profile selected from the group consisting of a polygonal profile, a circular profile, an ellipsoidal profile and an irregular pattern profile.

85. The method of claim 77, wherein the fluid channel is an HPLC column.

86. The method of claim 85, wherein said step of positioning said capacitor comprises:

- (i) providing a capillary;
- (ii) applying two conductive plates on opposite faces of said capillary; and
- (iii) filling said capillary with an HPLC stationary phase.

87. The method of claim 86, wherein said step of applying is effected from a procedure selected from the group consisting of evaporation, lift-off shadow-evaporation, nano-manipulation and focused ion milling.

88. The method of claim 77, wherein the fluid channel is a microchannel of a microfluidic device.

89. The method of claim 88, wherein said step of positioning said capacitor comprises:

(i) etching a non conductive substrate so as to provide a microchannel having walls; and

(ii) applying two conductive plates on opposite walls of said microchannel.

90. The method of claim 88, wherein said step of applying said two conductive plates comprises coating said opposite walls by a conductive material.

91. The method of claim 88, wherein said step of applying said two conductive plates is by ion implantation.

92. The method of claim 88, wherein said microfluidic device is selected from the group consisting of a drop ejector, a droplet microswitch, an extracellular electrode, a multi electrode array, a lab-on-chip device and a drug delivery microdevice.

93. The method of claim 77, wherein said step of connecting said capacitor to said capacitance measuring device is effected by a procedure selected from the group consisting of patterning, evaporation and ion implantation.

94. The method of claim 93, wherein said patterning is effected by a procedure selected from the group consisting of photolithography and lift-off technique.

95. The method of claim 77, wherein said electrical contacts comprise bonding pads.

96. The method of claim 77, wherein said capacitance measuring device is selected from the group consisting of a capacitance meter and a capacitance bridge.

97. The method of claim 77, wherein a size of said capacitor is in a nanometer scale.

98. The method of claim 77, wherein a size of said capacitor is in a millimeter scale.

99. The method of claim 77, wherein a size of said capacitor is in a centimeter scale.

100. The method of claim 77, wherein said capacitance measuring device is configured and designed to allow measuring of capacitance at a resolution of less than about 10 % of a total capacitance of said capacitor.

101. A method of monitoring dripping of a fluid from a fluid channel, the method comprising continuously measuring capacitance changes of a capacitor being formed on or integrated with the fluid channel, and using said capacitance changes to monitor a formation of a drop near an edge of the fluid channel.

102. The method of claim 101, wherein the fluid is selected from the group consisting of water, a body fluid, a bacterial cell suspension, a protein solution, an antibody solution, a nucleic acid solution and ink.

103. The method of claim 101, wherein said capacitor is positioned in proximity to said edge of the fluid channel.

104. The method of claim 101, wherein the fluid channel is a capillary.

105. The method of claim 104, wherein said capacitor comprises two conductive plates engaging opposite faces of said capillary.

106. The method of claim 104, wherein said capillary has a profile selected from the group consisting of a polygonal profile, a circular profile, an ellipsoidal profile and an irregular pattern profile.

107. The method of claim 101, wherein the fluid channel is an HPLC column.

108. The method of claim 107, wherein said capacitor comprises two conductive plates engaging opposite faces of said HPLC column.

109. The method of claim 101, wherein the fluid channel is a microchannel of a microfluidic device.

110. The method of claim 109, wherein said capacitor comprises two conductive plates engaging opposite walls of said microchannel.

111. The method of claim 109, wherein said microfluidic device is selected from the group consisting of a drop ejector, a droplet microswitch, an extracellular electrode and a multi electrode array.

112. The method of claim 101, wherein said capacitance measuring device is selected from the group consisting of a capacitance meter and a capacitance bridge.

113. The method of claim 101, wherein a size of said capacitor is in a nanometer scale.

114. The method of claim 101, wherein a size of said capacitor is in a millimeter scale.

115. The method of claim 101, wherein a size of said capacitor is in a centimeter scale.

116. The method of claim 101, wherein said capacitance measuring device is configured and designed to allow measuring of capacitance at a resolution of less than about 10 % of a total capacitance of said capacitor.

117. A method of controlling fluid locomotion in a fluid channel, the method comprising, using a variable cross-sectional area capacitor, being formed on or integrated with the fluid channel, for creating a non-uniform electric field capable of inducing polarization on molecules of the fluid, so as to generate dielectrophoretic forces on said molecules, thereby to control fluid locomotion.

118. The method of claim 117, wherein the fluid is selected from the group consisting of water, a body fluid, a bacterial cell suspension, a protein solution, an antibody solution, a nucleic acid solution and ink.

119. The method of claim 117, wherein said capacitor is positioned in proximity to an edge of the fluid channel, so as to control a rate of drop formation near said edge.

120. The method of claim 117, wherein said capacitor is positioned in proximity to an edge of the fluid channel, so as to control a shape and/or size of a drop formed near said edge.

121. The method of claim 117, wherein said capacitor comprises two conductive plates defining an inter-plate volume having a longitudinal axis, said conductive plates having constant transverse dimensions along said longitudinal axis.

122. The method of claim 117, wherein said capacitor comprises two conductive plates defining an inter-plate volume having a longitudinal axis, said conductive plates having a variable transverse dimensions along said longitudinal axis.

123. The method of claim 117, wherein the fluid channel is a capillary.

124. The method of claim 123, wherein said capacitor comprises two conductive plates engaging opposite faces of said capillary.

125. The method of claim 123, wherein said capillary has a profile selected from the group consisting of a polygonal profile, a circular profile, an ellipsoidal profile and an irregular pattern profile.

126. The method of claim 117, wherein the fluid channel is an HPLC column.

127. The method of claim 126, wherein said capacitor comprises two conductive plates engaging opposite faces of said HPLC column.

128. The method of claim 117, wherein the fluid channel is a microchannel of a microfluidic device.

129. The method of claim 128, wherein said capacitor comprises two conductive plates engaging opposite walls of said microchannel.

130. The method of claim 128, wherein said microfluidic device is selected from the group consisting of a drop ejector, a droplet microswitch, an extracellular electrode, a multi electrode array, a lab-on-chip device and a drug delivery microdevice.

131. The method of claim 117, wherein a size of said capacitor is in a nanometer scale.

132. The method of claim 117, wherein a size of said capacitor is in a millimeter scale.

133. The method of claim 117, wherein a size of said capacitor is in a centimeter scale.

134. A method of monitoring fluid locomotion in a fluid channel, the method comprising continuously measuring capacitance changes of a variable cross-sectional area capacitor being formed on or integrated with the fluid channel, and

using said capacitance changes to determine a location of the fluid in the fluid channel at any time, thereby to monitor fluid locomotion.

135. The method of claim 134, wherein the fluid is selected from the group consisting of water, a body fluid, a bacterial cell suspension, a protein solution, an antibody solution, a nucleic acid solution and ink.

136. The method of claim 134, wherein said capacitor is positioned in proximity to an edge of the fluid channel, so as to monitor of a rate of drop formation near said edge.

137. The method of claim 134, wherein said capacitor comprises two conductive plates defining an inter-plate volume having a longitudinal axis, said conductive plates having constant transverse dimensions along said longitudinal axis.

138. The method of claim 134, wherein said capacitor comprises two conductive plates defining an inter-plate volume having a longitudinal axis, said conductive plates having a variable transverse dimensions along said longitudinal axis.

139. The method of claim 134, wherein the fluid channel is a capillary.

140. The method of claim 139, wherein said capacitor comprises two conductive plates engaging opposite faces of said capillary.

141. The method of claim 139, wherein said capillary has a profile selected from the group consisting of a polygonal profile, a circular profile, an ellipsoidal profile and an irregular pattern profile.

142. The method of claim 134, wherein the fluid channel is an HPLC column.

143. The method of claim 142, wherein said capacitor comprises two conductive plates engaging opposite faces of said HPLC column.

144. The method of claim 134, wherein the fluid channel is a microchannel of a microfluidic device.

145. The method of claim 144, wherein said capacitor comprises two conductive plates engaging opposite walls of said microchannel.

146. The method of claim 144, wherein said microfluidic device is selected from the group consisting of a drop ejector, a droplet microswitch, an extracellular electrode, a multi electrode array, a lab-on-chip device and a drug delivery microdevice.

147. The method of claim 134, wherein a size of said capacitor is in a nanometer scale.

148. The method of claim 134, wherein a size of said capacitor is in a millimeter scale.

149. The method of claim 134, wherein a size of said capacitor is in a centimeter scale.

150. The method of claim 134, wherein said capacitance measuring device is selected from the group consisting of a capacitance meter and a capacitance bridge.

151. The method of claim 134, wherein said capacitance measuring device is configured and designed to allow measuring of capacitance at a resolution of less than about 10 % of a total capacitance of said capacitor.